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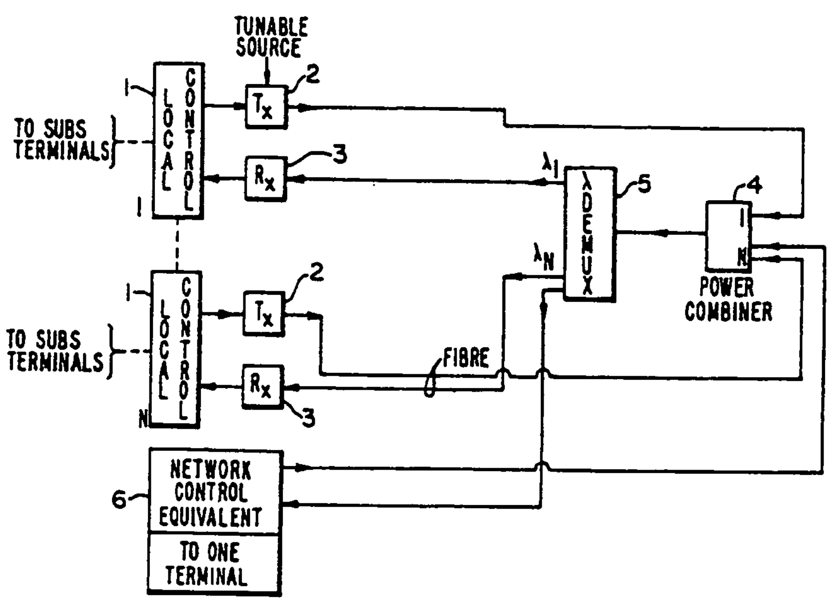
(54) Title: OPTICAL NETWORKS



(57) Abstract

An optical wideband network has a plurality of stations (1) each having a transmitter (2) and a receiver (3). One of the transmitter (2) and the receiver (3) is tunable under the control of a common control system (6). The stations (1) are optically coupled together such that signals from each transmitter (2) are transmitted to all the receivers (3). The control system is adapted to control the wavelength of signals transmitted by and/or detected by the stations (1) whereby the network may be configured into a plurality of topologies of groups of three or more stations (1) by the control system (6).

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Optical Networks

The invention relates to optical networks, for example optical communication networks such as local area networks.

The use of optical signal wavelength switching to achieve communication between a transmitting terminal and a selected receiving terminal has already been proposed in for example CA-A-1,052,865 and "Future Optical Carrier Frequency Technology in Glass Fibre Networks" by Clemens Baack, Ernst-J and Bachus, Bernhard Strebel in NTZ Vol 35 (1982) Number 11. These prior art documents describe networks having a very limited capability in simply allowing one to one (or point to point) communication between terminals. Such networks are suitable for telephony or viewphone but there is an increasing requirement for more complex networks which allow facilities such as document distribution, entertainment services, and conference calls to be provided. These three facilities represent examples of one to many communication, many to one communication, and many to many communication respectively. Up to now, the different services have been provided by isolated sets of terminals having physical topologies which are fixed in dependence upon the facility provided. This is costly in terms of hardware and inherently unattractive to a user requiring more than one facility since additional physical topologies would be required for each facility.

In accordance with the present invention, an optical wideband network has a plurality of first transmitting and first receiving terminals; and a common control system, the terminals being optically coupled together such that signals from each first transmitting terminal are transmitted to all the first receiving terminals, and the control system being adapted to control the

wavelength of signals transmitted by and/or detected by the terminals whereby the network may be configured into a plurality of topologies of groups of three or more terminals by the control system.

The invention provides a network which is much more versatile than conventional networks in allowing variable topologies to be set up by the common control system making use of the wavelength switching principle and without having to change the physical topology. This enables the physical topology to be constructed with a minimum of optical waveguide leading to low cost and simplicity. The control system may be positioned at a central site from where it will control which terminals are connected in groups. Furthermore, it can allow several different groups of terminals to operate simultaneously, the topology of each group being independent of the other groups.

The control system can also be used to allocate channels of different bandwidths depending on the capabilities of the terminals, and has applications in telephone communication and video.

Typically, the terminals will be optically coupled via monomode optical fibres to minimise power loss and to exploit fully the wavelength multiplexing capability. However, other optical waveguides could be used where appropriate.

In one example, each first transmitting terminal includes tuning means for setting the wavelength of the respective optical carrier signals, the control means being adapted to control the tuning means of one or more groups of terminals whereby communication is achieved between the terminals in each group. The advantage of this network is that there is inherent security since the receiving terminals are only sensitive to fixed frequencies and thus can only receive designated signals.

In an alternative example, each first receiving terminal includes tuning means for setting the wavelength to which the receiving terminal is sensitive.

Preferably, each transmitting terminal is optically coupled with a common wavelength multiplexing means which provides a plurality of multiplexed outputs, each output being coupled with a respective first receiving terminal.

The wavelength multiplexing means may be a conventional wavelength multiplexer in combination with a wavelength demultiplexer or a power combiner/splitter combination.

Conveniently, the network comprises a plurality of stations each having a first transmitting terminal and a second transmitting terminal and a first receiving terminal and a second receiving terminal arranged such that point to point communication between the stations may be achieved via the second transmitting and receiving terminals simultaneously but independently of communication between groups of three or more stations via the first transmitting and receiving terminals.

Some examples of optical wideband networks in accordance with the present invention will now be described with reference to the accompanying drawings, in which:-

Figure 1 is a schematic block diagram of one example;

Figure 2 is a schematic block diagram of a second example;

Figure 3 is a schematic block diagram of a third example;

Figure 4 is a modification of the Figure 3 example; and,

Figure 5 and 6 ilustrate networks formed by a plurality of subsidiary networks.

The example shown in Figure 1 is a local area network having N stations 1, each station having an optical signal transmitter 2 and an optical signal receiver 3. The transmitters 2 are tunable, as explained below, so that an optical carrier signal of a selected wavelength is transmitted. Each receiver 3 is sensitive to a fixed optical wavelength, the optical wavelength being different for each receiver.

The transmitters 2 are all connected to a power combiner 4 in which the signals from the transmitters 2 are combined and fed to a wavelength demultiplexer 5 having N outputs connected to respective receivers 3.

The tuning of the sources 2 is controlled by a central network control terminal 6 provided in the network.

In order to achieve a network with a ring topology in which for example four of the stations 1 (A, B, C, and D) are connected in a ring, the network control terminal 6 causes the transmitter 2 of station A to transmit a carrier signal having a wavelength corresponding to that sensed by the receiver of station B. The transmitter 2 of station B transmits a signal which is sensed by the receiver of station C and the transmitters of stations C and D are similarly controlled so that a small communication ring is set up.

It will be understood that the remaining stations 1 can be combined in a similar way into other topologies including one to one communication.

Physically, the monomode fibre connections between the stations and the wavelength demultiplexer 5 would be configured as a star. The power combiner 4, however, can be a distributed component and therefore this part of the network could be configured in a tree and branch structure to minimise optical fibre.

The network control terminal 6 is equivalent to the stations 1 and can be lcoated anywhere within the network. The network apart from the stations is therefore totally passive. The network control terminal 6 may be located at a central site with the splitting/combining function but only if operationally convenient.

An alternative example is shown in Figure 2. In this example, the transmitters 2 transmit optical carrier signals with a fixed wavelength different for each station 1 but the receivers 3 are tunable by the network control terminal 6.

The transmitters 2 are optically coupled via monomode optical fibres with a wavelength multiplexer 7 whose output is connected to a power splitter 8 having N outputs connected to respective receivers 3.

Operation of this network is similar to that shown in Figure 1 except that the receivers 3 are tuned to be sensitive to selected wavelengths This network allows one to many communication to be achieved. The network control tunes each of a selected group of receivers 3 to the wavelength of a transmitter 2 which is to generate a broadcast message.

In principle, the tuning range of the filters of the receivers 3 can cover the whole of the optical window e.g. 1250 mm to 1600 mm. With presently available direct detect systems the number of stations 1 will be limited by the power splitter 8 to about three hundred, whereas coherent systems enable the number stations to be up to 1000 or more.

The network shown in Figure 3 is identical to that shown in Figure 2 except that the wavelength multiplexer has been replaced by a power combiner 9. This realises the simplest passive network at the expense of extra loss due to the power combiner 9.

Figure 4 illustrates a modified version of the Figure 3 example. In the Figure 4 example, the power splitter 8 and power combiner 9 of Figure 3 have been replaced by an N-way transmissive star coupler 10. This network is far more versatile than either of the networks of Figures 1 and 2 since it allows both the transmitters 2 and receivers 3 to be tunable. Furthermore the losses introduced by the power splitter 8 and power combiner 9 in the Figure 3 example have been reduced to the level of losses in the Figures 1 and 2 examples. This can allow assignment of wavelengths on an "on demand" or traffic basis rather than allocation to specific terminals. In addition, there is no critical matching of the terminal components to the network components making fabrication and implementation much simpler.

It should be understood that in all the examples described, the network control terminal 6 is formed by a standard terminal on the network (which could be located anywhere in the network) interfaced to a control computer. All call/topological set ups between terminals are arranged via the control computer and thus each terminal 1 communicates with the network control terminal 6 during call set up.

The above examples are all of small networks but these could be built into larger networks by using selected terminals 1 from each network back to back as gateways between the small "elemental" networks. This is illustrated in Figure 5 in which networks 1-N are linked together by terminals 1 via optical fibre links. It should be noted that the networks are connected physically in a loop so that each network can communicate with each other network via two alternative paths. For example, the network 1 can communicate with the network N either directly or via the network 2.

In an alternative arrangement, illustrated in Figure 6, the "elemental" networks could be interconnected via an optical space switch 11. There is additional control complexity with this space switch 11 in that the "elemental" network controls will need to communicate with a switch control 12 in order to arrange call set up through the space switch 11. This could fairly readily be implemented by a polling system whereby the switch polls each of the three gateway terminals 1 sequentially and has a local memory map of the status of the space switch.

CLAIMS

1. An optical wideband network having a plurality of first transmitting and first receiving terminals; and a common control system, the terminals being optically coupled together such that signals from each first transmitting terminal are transmitted to all the first receiving terminals, and the control system being adapted to configure the network into a plurality of topologies of groups of three or more terminals by controlling the wavelength of signals transmitted by and/or detected by the terminals.

2. A network according to claim 1, wherein each first transmitting terminal includes tuning means for setting the wavelength of the respective optical carrier signals, the control means being adapted to control the tuning means of one or more group of terminals whereby communication is achieved between the terminals in each group.

3. A network according to claim 2, wherein each transmitting terminal is optically coupled with a common wavelength multiplexing means which provides multiplexed outputs coupled with each receiving terminal.

4. A network according to any one of claims 1, 2 or 3, the network comprising a plurality of stations each having a first transmitting terminal and a second transmitting terminal and a first receiving terminal and a second receiving terminal arranged such that point to point communication between the stations may be achieved via the second transmitting and receiving terminals simultaneously but independently of communication between groups of three or more stations via the first transmitting and receiving terminals.

Fig.1.

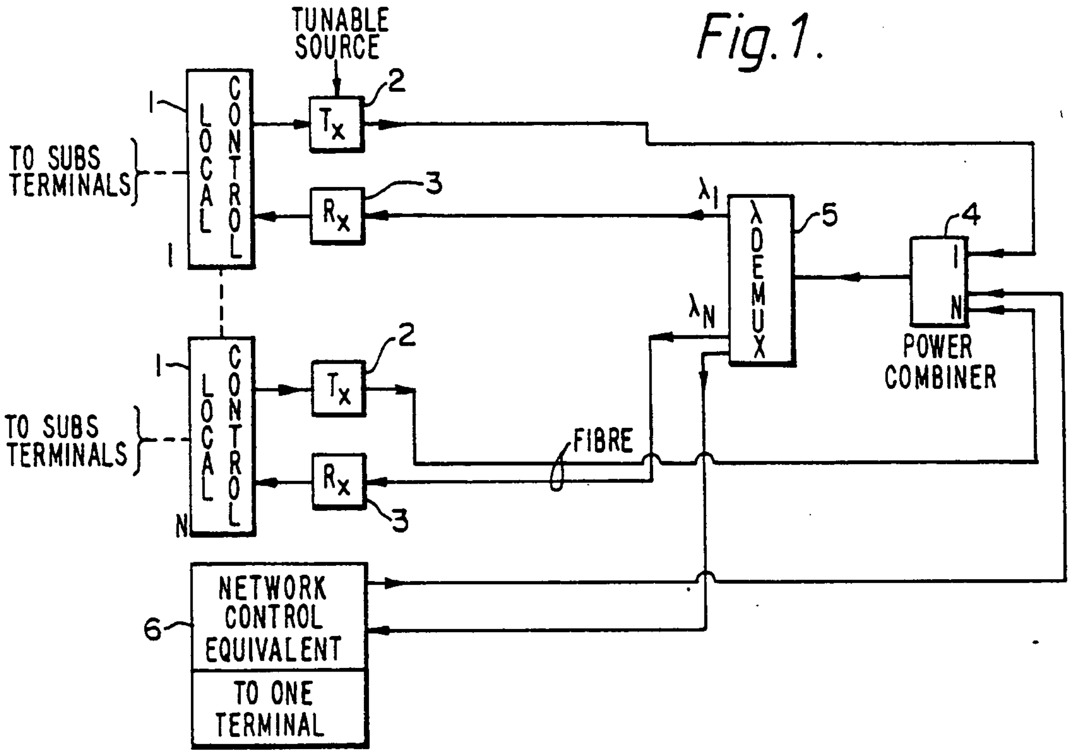

Fig.2.

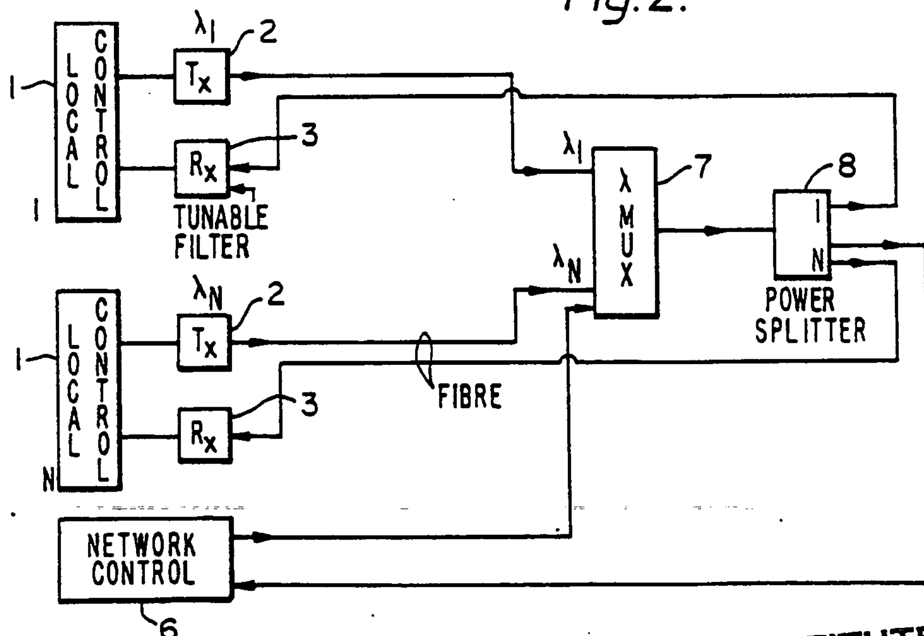

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Fig. 3.

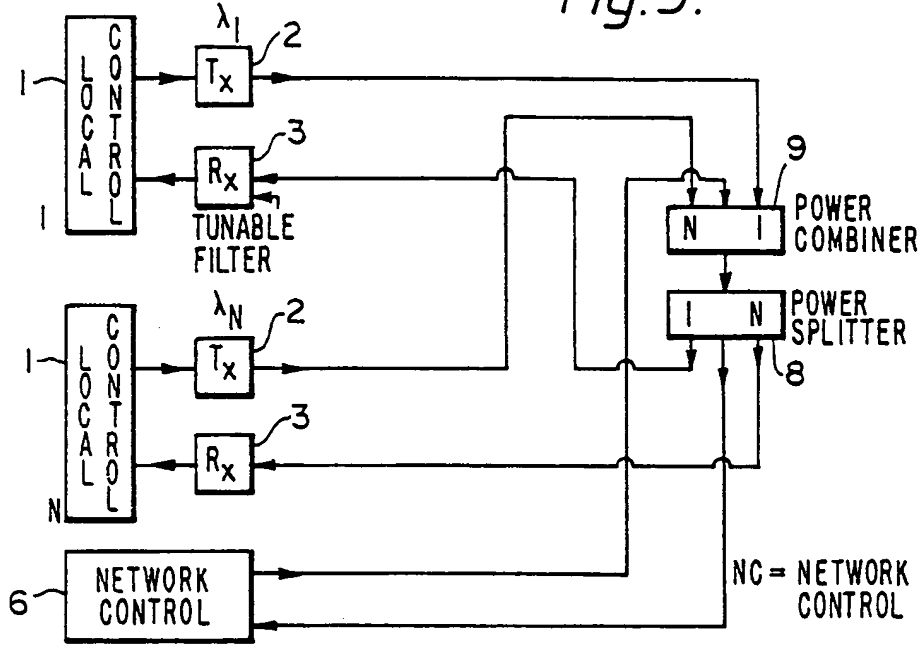

Fig. 4.

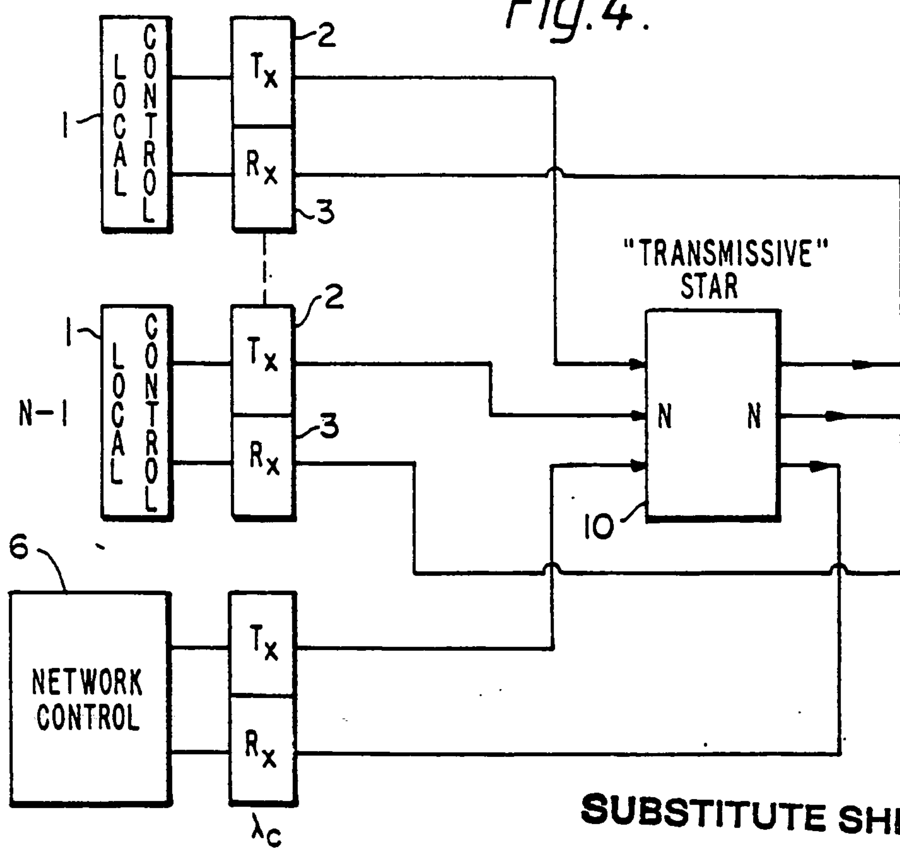

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Fig.5.

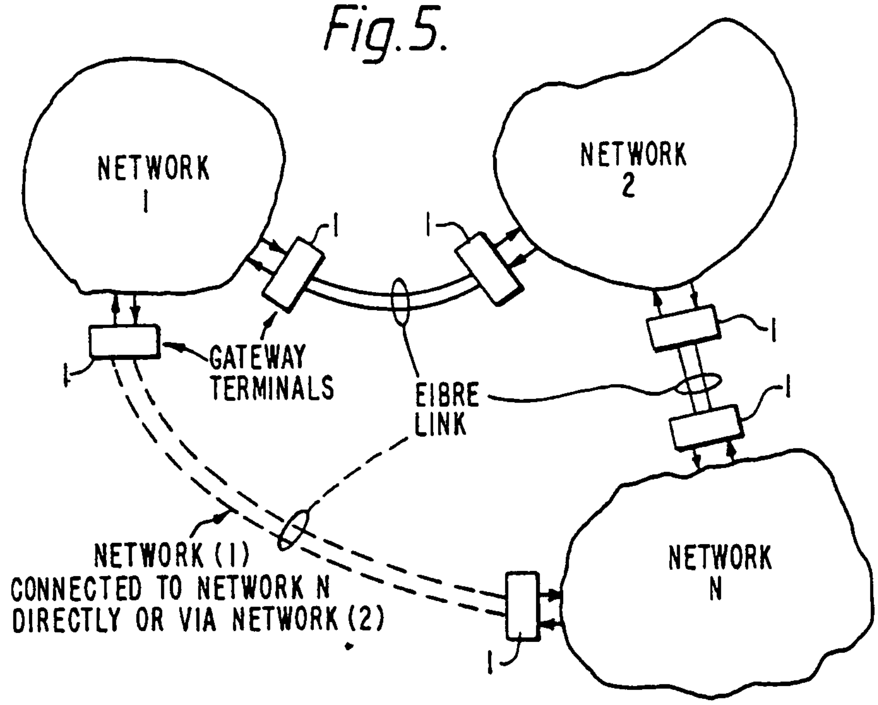
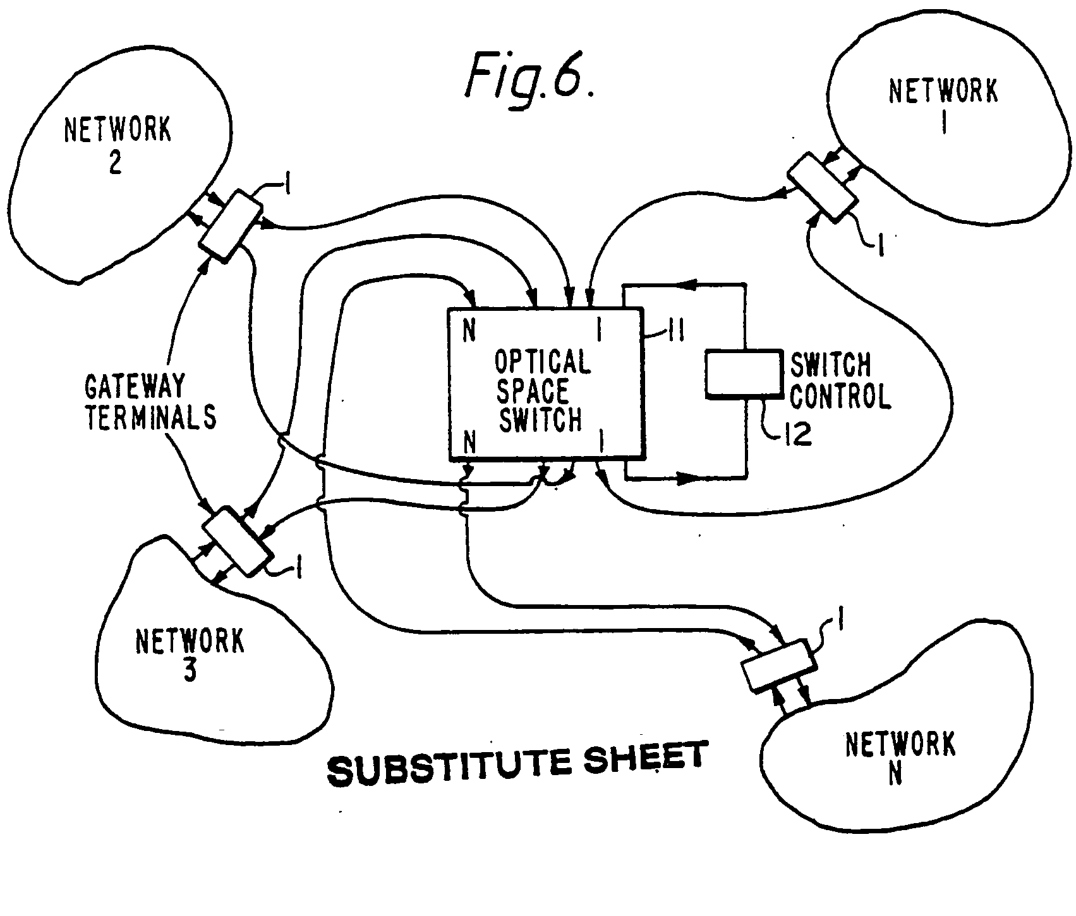

NETWORK
1
NETWORK
2
GATEWAY
TERMINALS
EIBRE
LINK
NETWORK (1)
CONNECTED TO NETWORK N
DIRECTLY OR VIA NETWORK (2)
NETWORK
N

Fig.6.


NETWORK
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TERMINALS
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SWITCH
SWITCH
CONTROL
12
11
NETWORK
3
NETWORK
N

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 86/00134

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: H 04 Q 11/02; H 04 J 15/00; H 04 B 9/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	H 04 Q H 04 J H 04 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	EP, A, 0077292 (HEINRICH-HERTZ) 20 April 1983, see page 3, lines 3-17; page 5, lines 10-18; page 7, line 26 - page 8, line 14; page 14, lines 13-34 --	1-2
A	GB, A, 2043240 (THE POST OFFICE) 1 October 1980, see page 1, lines 33-89	1-3

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/GB 86/00134 (SA 12502)

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A- 0077292	20/04/83	JP-A-	58129847	03/08/83
		DE-A-	3237845	11/08/83
		US-A-	4530084	16/07/85
		CA-A-	1199074	07/01/86
GB-A- 2043240	01/10/80	None		

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